Overview of Canada's Action Plan on Aviation Emissions and Alternative Fuels

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Purpose

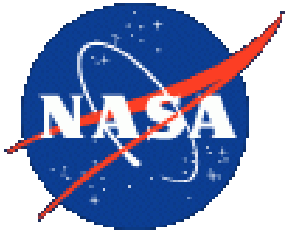
- Outline Canada's roles, responsibilities and activities related to aviation emissions and alternative fuels.

Canadian and US Federal Organizations

Transport Canada

Transports Canada

NRC·CNRC



Transport Canada's Responsibilities

- Ensures a safe, secure, efficient and environmentally responsible Canadian transportation system
  - Assess safety, security and economic implications in proposed environmental measures
- Regulates all emissions from the aviation, marine and rail sectors – leads Canadian participation and involvement at the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO)
- Removes barriers to enable take-up of clean technologies – e.g., modernized and harmonized codes, standards, test protocols, targeted incentives, research

The Current Approach

The Government of Canada promotes clean transportation by:

1. **Creating and implementing regulatory regimes:**
   - In consultation with our partners, such as the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO), and aligned with the U.S., where appropriate;
   - Sector-by-sector approach.

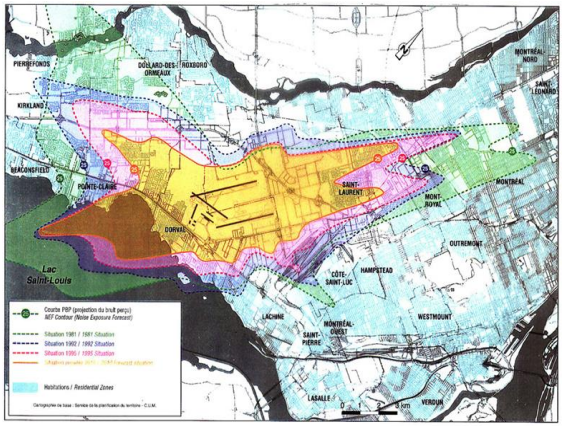
2. **Implementing complementary measures to support the uptake of clean transportation technologies and innovative practices:**
   - Voluntary agreements with industry;
   - Programs that provide economic incentives to support deployment;
   - Research and information on new technologies.

Common Objectives

- Environmental goals include reducing or minimizing:
  - aircraft noise
  - impacts on air quality
  - impacts on the global climate
- R&D is a key component
  - Improved measurement / understanding
  - Clean technology
  - Efficient operations

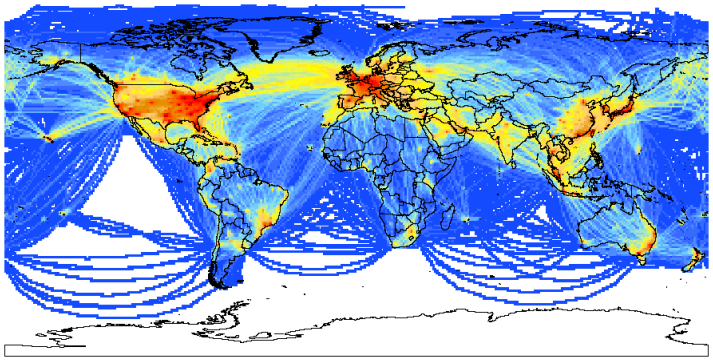
Aviation Environmental Impacts

Noise Impacts



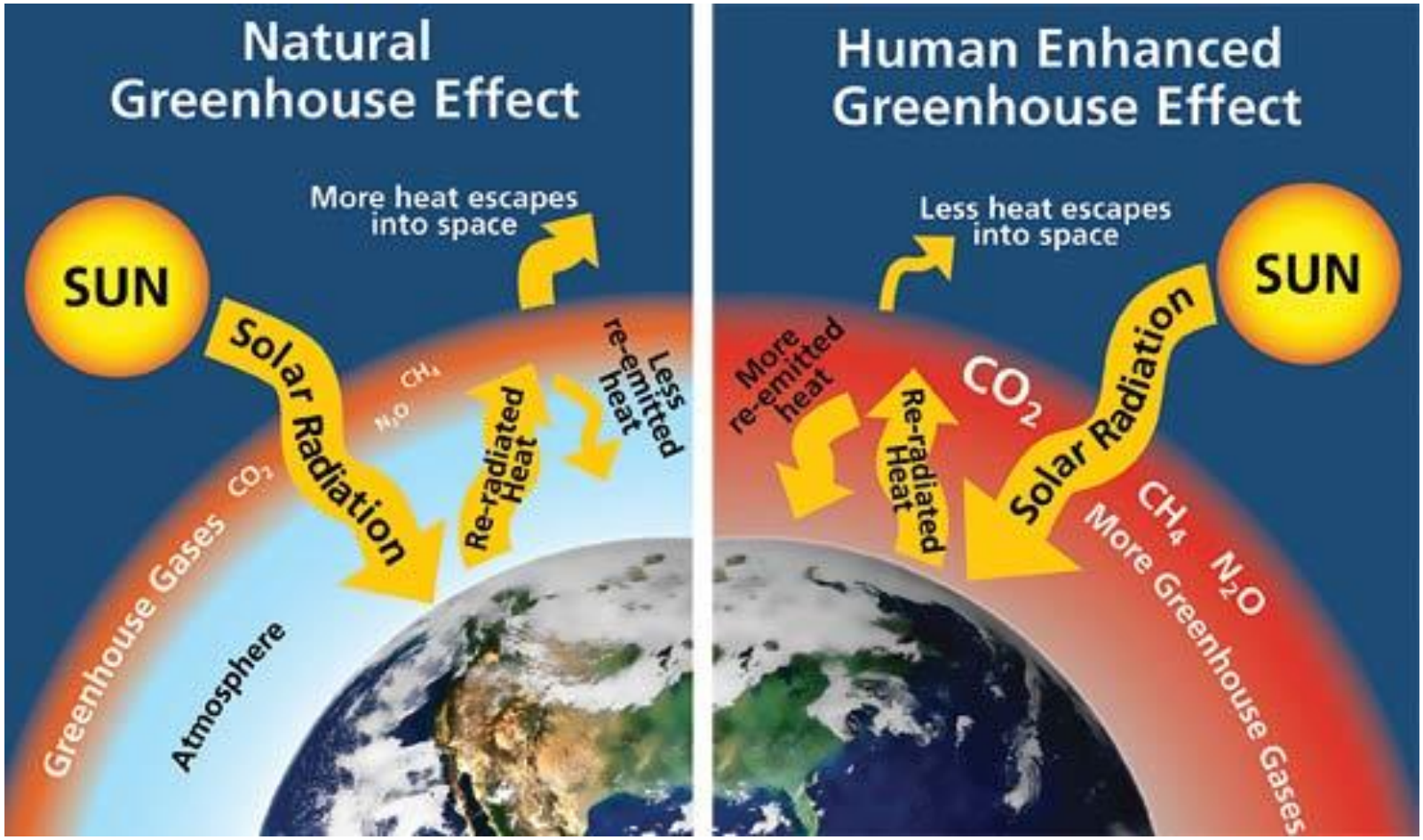
Air Quality Impacts

Climate Impacts

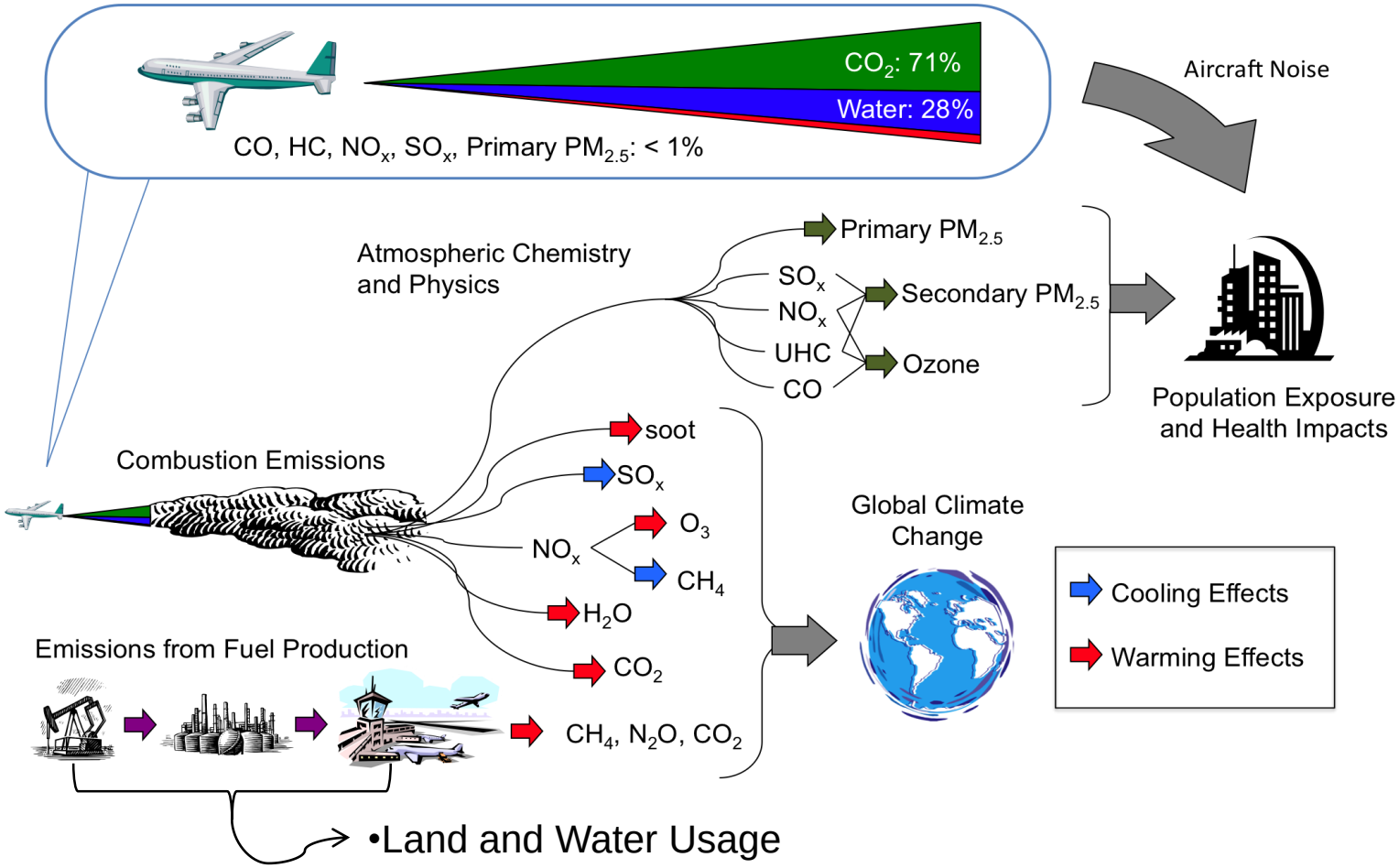


Other Impacts

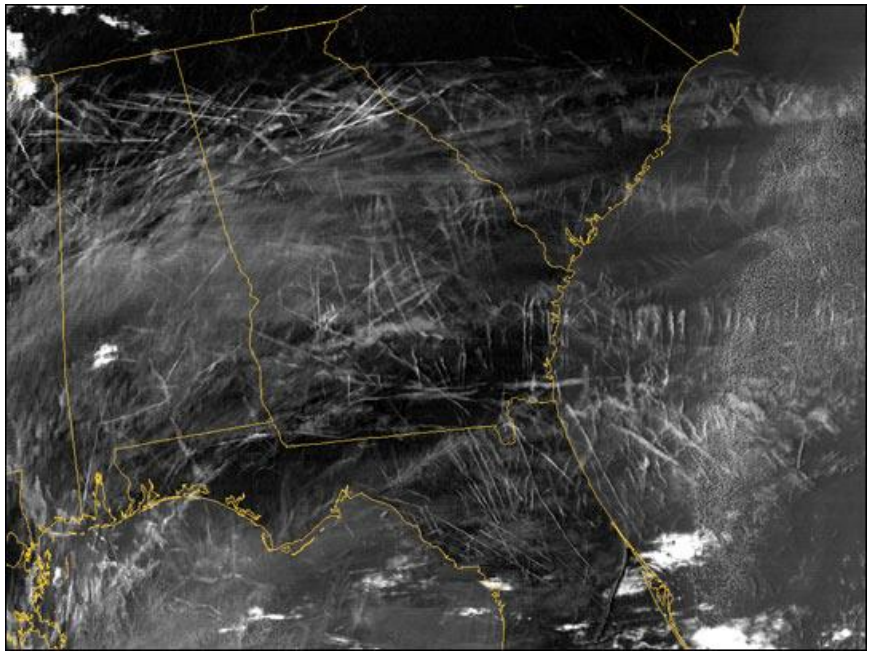
What's Missing?



Aviation Environmental Impacts

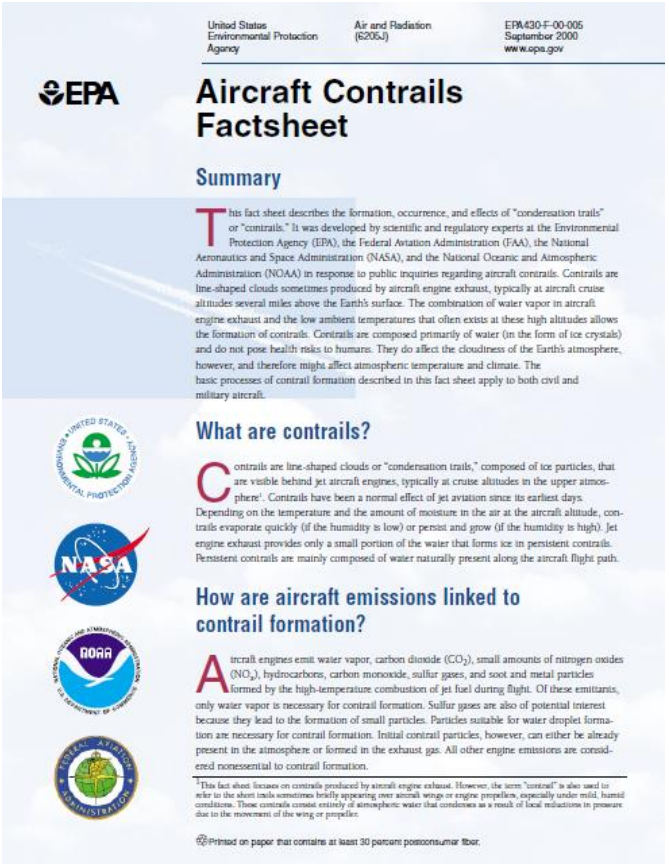


Aircraft Condensation Trails
“Contrails”



Why Study Aircraft Engine Emissions and Contrails?

- Public concern
- Emissions deposited at cruise altitudes
- Climate impacts
  - Significance of H_2O
  - Role of particulate matter (including Black Carbon)
  - Impacts from alternative fuels



United States Environmental Protection Agency | Air and Radiation (6205J) | EPA430-F-00-005 September 2000 www.epa.gov

EPA

Aircraft Contrails Factsheet

Summary

This fact sheet describes the formation, occurrence, and effects of "condensation trails" or "contrails." It was developed by scientific and regulatory experts at the Environmental Protection Agency (EPA), the Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA) in response to public inquiries regarding aircraft contrails. Contrails are line-shaped clouds sometimes produced by aircraft engine exhaust, typically at aircraft cruise altitudes several miles above the Earth's surface. The combination of water vapor in aircraft engine exhaust and the low ambient temperatures that often exists at these high altitudes allows the formation of contrails. Contrails are composed primarily of water (in the form of ice crystals) and do not pose health risks to humans. They do affect the cloudiness of the Earth's atmosphere, however, and therefore might affect atmospheric temperature and climate. The basic processes of contrail formation described in this fact sheet apply to both civil and military aircraft.

What are contrails?

Contrails are line-shaped clouds or "condensation trails," composed of ice particles, that are visible behind jet aircraft engines, typically at cruise altitudes in the upper atmosphere[1]. Contrails have been a normal effect of jet aviation since its earliest days. Depending on the temperature and the amount of moisture in the air at the aircraft altitude, contrails evaporate quickly (if the humidity is low) or persist and grow (if the humidity is high). Jet engine exhaust provides only a small portion of the water that forms ice in persistent contrails. Persistent contrails are mainly composed of water naturally present along the aircraft flight path.

How are aircraft emissions linked to contrail formation?

Aircraft engines emit water vapor, carbon dioxide (CO_2), small amounts of nitrogen oxides (NO_x), hydrocarbons, carbon monoxide, sulfur gases, and soot and metal particles formed by the high-temperature combustion of jet fuel during flight. Of these emittants, only water vapor is necessary for contrail formation. Sulfur gases are also of potential interest because they lead to the formation of small particles. Particles suitable for water droplet formation are necessary for contrail formation. Initial contrail particles, however, can either be already present in the atmosphere or formed in the exhaust gas. All other engine emissions are considered nonessential to contrail formation.

[1]This fact sheet focuses on contrails produced by aircraft engine exhaust. However, the term "contrail" is also used to refer to the short trails sometimes briefly appearing over aircraft wings or engine propellers, especially under mild, humid conditions. These contrails consist entirely of atmospheric water that condenses as a result of local reductions in pressure due to the movement of the wing or propeller.

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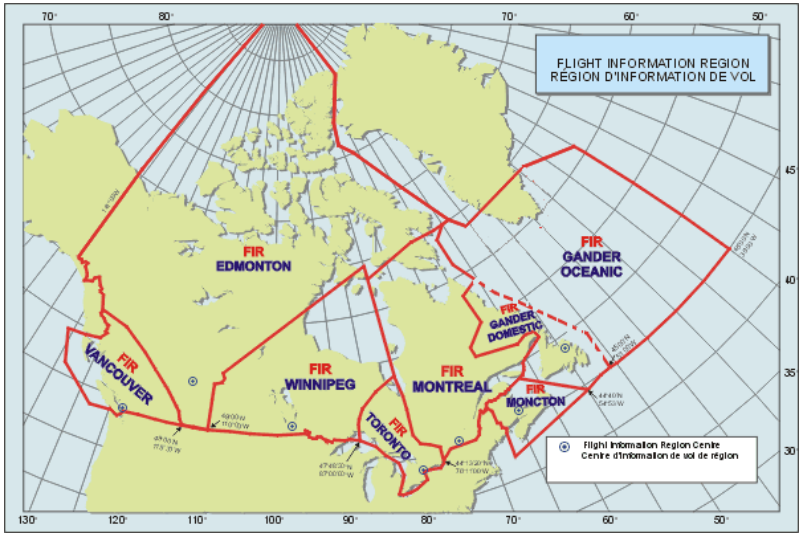
Canada's Airspace

- World's second-largest ANSP (by traffic volume)
- 12 million aircraft movements a year
- 18 million square kilometres (domestic airspace and out to centre of the North Atlantic… *> 1,200 flights/day*)
- Areas of significant importance for contrails



NAV CANADA

Canada's Action Plan to Reduce GHG Emissions from Aviation

Goals:

- 2% fuel efficiency/year from 2005 to 2020
- Carbon neutral growth from 2020
- Absolute 50% GHG reductions by 2050

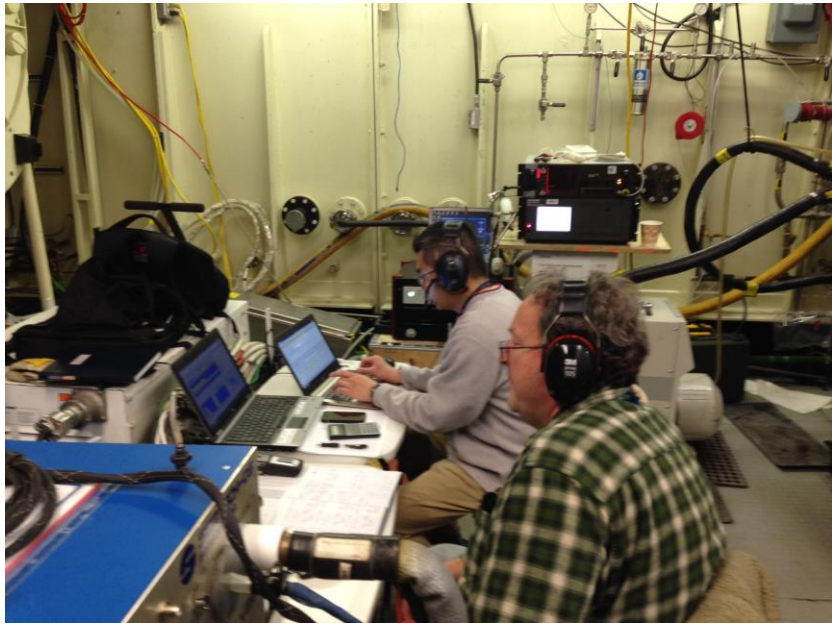
Measures:

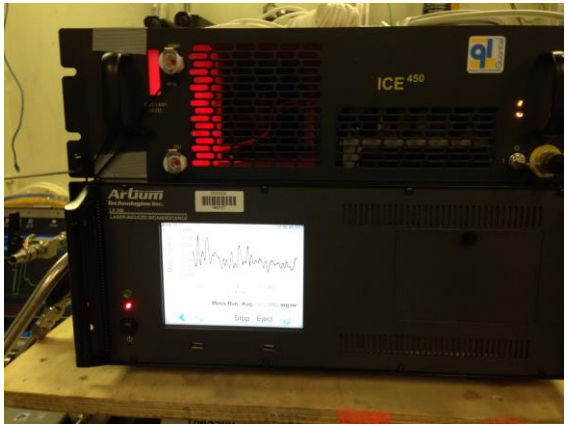
- Fleet renewal
- Improved ATM
- **Alternative aviation fuels**

Canadian Aviation Environmental Research Priority Areas and Efforts

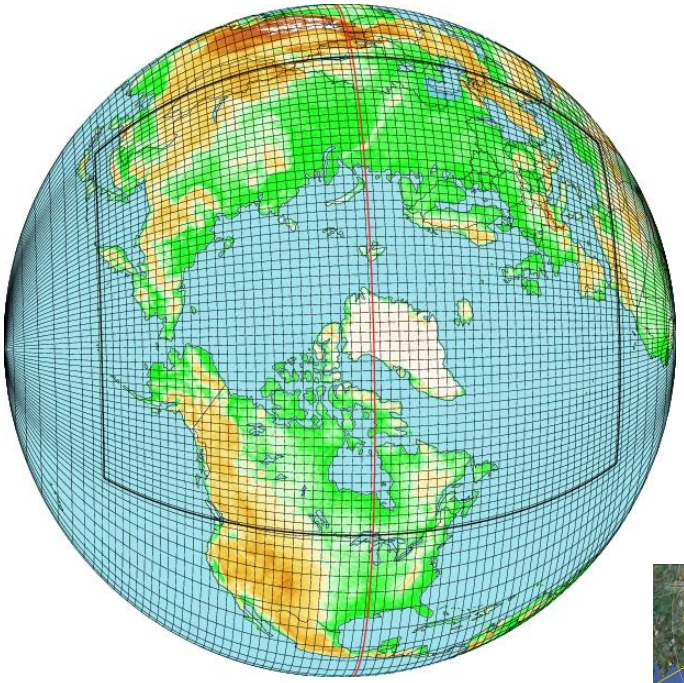
1. **Aviation Impacts on the Global Climate**
   - Aviation Emissions Impacts in the Arctic (York U/EC/FAA)
   - New ICAO aircraft CO2 standard (ASCENT)
2. **Aviation Impacts on Air Quality**
   - Cdn measurement technology (LII 300) and real-time calibration technology for new ICAO nvPM standard and methodology (NRC/GARDN/ASCENT)
     **also important for climate impacts*
3. **Aviation Alternative Fuels**
   - ICAO Alternative Fuels Task Force
   - Fuel, engine and flight testing (GARDN/NRC/EC)
   - NASA ACCESS II (NRC/NASA/FAA)
   - Cdn biojet value chain assessment (BFN/ASCENT)

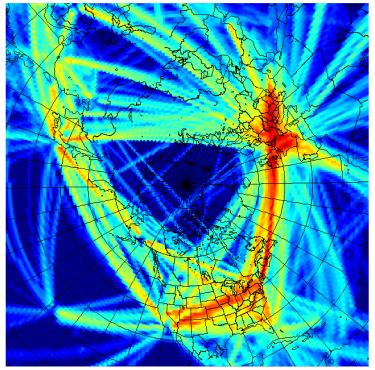
Canadian Research – Measurement & Testing

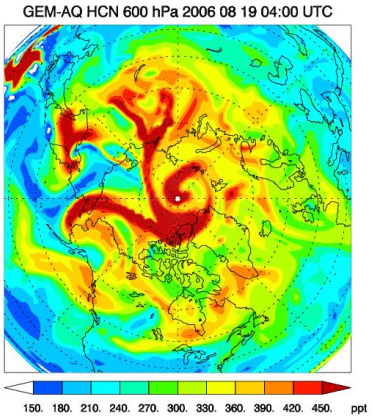


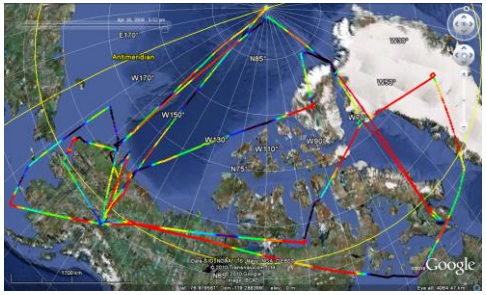


Canadian Research – Modelling









Canadian Research – Alternative Fuels
BioFuelNet Canada

Public-Private Network

- brings together the Cdn biofuels research community to address key challenges

Task Force 6: Aviation *(*new)*

- involve researchers in feedstock, conversion, engine operations, policy, LCA, economics and supply chain.

RÉSEAU BIOFUELNET CANADA

Need estimated at 200 - 250 million litres by 2020

Next Steps – Continued Collaborations with Key Partners

Green Aviation
Research & Development
Network

Groupement Aéronautique
de Recherche et Développement
en eNvironnement